

## Chapter 112. Texas Essential Knowledge and Skills for Science

### Subchapter A. Elementary

*Statutory Authority: The provisions of this Subchapter A issued under the Texas Education Code, §7.102(c)(4) and §28.002, unless otherwise noted.*

#### **§112.10. Implementation of Texas Essential Knowledge and Skills for Science, Elementary, Beginning with School Year 2010-2011.**

The provisions of §§112.11-112.16 of this subchapter shall be implemented by school districts beginning with the 2010-2011 school year.

*Source: The provisions of this §112.10 adopted to be effective August 4, 2009, 34 TexReg 5063; amended to be effective August 24, 2010, 35 TexReg 7230.*

#### **§112.11. Science, Kindergarten, Beginning with School Year 2010-2011.**

(a) Introduction.

- (1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."
- (2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.
- (3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 80% of instructional time.
- (4) In Kindergarten, students observe and describe the natural world using their five senses. Students do science as inquiry in order to develop and enrich their abilities to understand scientific concepts and processes. Students develop vocabulary through their experiences investigating properties of common objects, earth materials, and organisms.
  - (A) A central theme throughout the study of scientific investigation and reasoning; matter and energy; force, motion, and energy; Earth and space; and organisms and environment is active engagement in asking questions, communicating ideas, and exploring with scientific tools. Scientific investigation and reasoning involves practicing safe procedures, asking questions about the natural world, and seeking answers to those questions through simple observations and descriptive investigations.
  - (B) Matter is described in terms of its physical properties, including relative size and mass, shape, color, and texture. The importance of light, heat, and sound energy is identified as it relates to the students' everyday life. The location and motion of objects are explored.
  - (C) Weather is recorded and discussed on a daily basis so students may begin to recognize patterns in the weather. Other patterns are observed in the appearance of objects in the sky.
  - (D) In life science, students recognize the interdependence of organisms in the natural world. They understand that all organisms have basic needs that can be satisfied through interactions with living and nonliving things. Students will investigate the life cycle of plants and identify likenesses between parents and offspring.

(b) Knowledge and skills.

- (1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and uses environmentally appropriate and responsible practices. The student is expected to:
  - (A) identify and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately;
  - (B) discuss the importance of safe practices to keep self and others safe and healthy; and
  - (C) demonstrate how to use, conserve, and dispose of natural resources and materials such as conserving water and reusing or recycling paper, plastic, and metal.
- (2) Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations. The student is expected to:
  - (A) ask questions about organisms, objects, and events observed in the natural world;
  - (B) plan and conduct simple descriptive investigations such as ways objects move;
  - (C) collect data and make observations using simple equipment such as hand lenses, primary balances, and non-standard measurement tools;
  - (D) record and organize data and observations using pictures, numbers, and words; and
  - (E) communicate observations with others about simple descriptive investigations.
- (3) Scientific investigation and reasoning. The student knows that information and critical thinking are used in scientific problem solving. The student is expected to:
  - (A) identify and explain a problem such as the impact of littering on the playground and propose a solution in his/her own words;
  - (B) make predictions based on observable patterns in nature such as the shapes of leaves; and
  - (C) explore that scientists investigate different things in the natural world and use tools to help in their investigations.
- (4) Scientific investigation and reasoning. The student uses age-appropriate tools and models to investigate the natural world. The student is expected to:
  - (A) collect information using tools, including computers, hand lenses, primary balances, cups, bowls, magnets, collecting nets, and notebooks; timing devices, including clocks and timers; non-standard measuring items such as paper clips and clothespins; weather instruments such as demonstration thermometers and wind socks; and materials to support observations of habitats of organisms such as terrariums and aquariums; and
  - (B) use senses as a tool of observation to identify properties and patterns of organisms, objects, and events in the environment.
- (5) Matter and energy. The student knows that objects have properties and patterns. The student is expected to:
  - (A) observe and record properties of objects, including relative size and mass, such as bigger or smaller and heavier or lighter, shape, color, and texture; and
  - (B) observe, record, and discuss how materials can be changed by heating or cooling.
- (6) Force, motion, and energy. The student knows that energy, force, and motion are related and are a part of their everyday life. The student is expected to:
  - (A) use the five senses to explore different forms of energy such as light, heat, and sound;
  - (B) explore interactions between magnets and various materials;

- (C) observe and describe the location of an object in relation to another such as above, below, behind, in front of, and beside; and
  - (D) observe and describe the ways that objects can move such as in a straight line, zigzag, up and down, back and forth, round and round, and fast and slow.
- (7) Earth and space. The student knows that the natural world includes earth materials. The student is expected to:
- (A) observe, describe, compare, and sort rocks by size, shape, color, and texture;
  - (B) observe and describe physical properties of natural sources of water, including color and clarity; and
  - (C) give examples of ways rocks, soil, and water are useful.
- (8) Earth and space. The student knows that there are recognizable patterns in the natural world and among objects in the sky. The student is expected to:
- (A) observe and describe weather changes from day to day and over seasons;
  - (B) identify events that have repeating patterns, including seasons of the year and day and night; and
  - (C) observe, describe, and illustrate objects in the sky such as the clouds, Moon, and stars, including the Sun.
- (9) Organisms and environments. The student knows that plants and animals have basic needs and depend on the living and nonliving things around them for survival. The student is expected to:
- (A) differentiate between living and nonliving things based upon whether they have basic needs and produce offspring; and
  - (B) examine evidence that living organisms have basic needs such as food, water, and shelter for animals and air, water, nutrients, sunlight, and space for plants.
- (10) Organisms and environments. The student knows that organisms resemble their parents and have structures and processes that help them survive within their environments. The student is expected to:
- (A) sort plants and animals into groups based on physical characteristics such as color, size, body covering, or leaf shape;
  - (B) identify parts of plants such as roots, stem, and leaves and parts of animals such as head, eyes, and limbs;
  - (C) identify ways that young plants resemble the parent plant; and
  - (D) observe changes that are part of a simple life cycle of a plant: seed, seedling, plant, flower, and fruit.

*Source: The provisions of this §112.11 adopted to be effective August 4, 2009, 34 TexReg 5063.*

**§112.12. Science, Grade 1, Beginning with School Year 2010-2011.**

- (a) Introduction.
- (1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."
  - (2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.

- (3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 80% of instructional time.
- (4) In Grade 1, students observe and describe the natural world using their five senses. Students do science as inquiry in order to develop and enrich their abilities to understand the world around them in the context of scientific concepts and processes. Students develop vocabulary through their experiences investigating properties of common objects, earth materials, and organisms.
  - (A) A central theme in first grade science is active engagement in asking questions, communicating ideas, and exploring with scientific tools in order to explain scientific concepts and processes like scientific investigation and reasoning; matter and energy; force, motion, and energy; Earth and space; and organisms and environment. Scientific investigation and reasoning involves practicing safe procedures, asking questions about the natural world, and seeking answers to those questions through simple observations and descriptive investigations.
  - (B) Matter is described in terms of its physical properties, including relative size and mass, shape, color, and texture. The importance of light, heat, and sound energy is identified as it relates to the students' everyday life. The location and motion of objects are explored.
  - (C) Weather is recorded and discussed on a daily basis so students may begin to recognize patterns in the weather. In addition, patterns are observed in the appearance of objects in the sky.
  - (D) In life science, students recognize the interdependence of organisms in the natural world. They understand that all organisms have basic needs that can be satisfied through interactions with living and nonliving things. Students will investigate life cycles of animals and identify likenesses between parents and offspring.
- (b) Knowledge and skills.
  - (1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and uses environmentally appropriate and responsible practices. The student is expected to:
    - (A) recognize and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately;
    - (B) recognize the importance of safe practices to keep self and others safe and healthy; and
    - (C) identify and learn how to use natural resources and materials, including conservation and reuse or recycling of paper, plastic, and metals.
  - (2) Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations. The student is expected to:
    - (A) ask questions about organisms, objects, and events observed in the natural world;
    - (B) plan and conduct simple descriptive investigations such as ways objects move;
    - (C) collect data and make observations using simple equipment such as hand lenses, primary balances, and non-standard measurement tools;
    - (D) record and organize data using pictures, numbers, and words; and
    - (E) communicate observations and provide reasons for explanations using student-generated data from simple descriptive investigations.

- (3) Scientific investigation and reasoning. The student knows that information and critical thinking are used in scientific problem solving. The student is expected to:
  - (A) identify and explain a problem such as finding a home for a classroom pet and propose a solution in his/her own words;
  - (B) make predictions based on observable patterns; and
  - (C) describe what scientists do.
- (4) Scientific investigation and reasoning. The student uses age-appropriate tools and models to investigate the natural world. The student is expected to:
  - (A) collect, record, and compare information using tools, including computers, hand lenses, primary balances, cups, bowls, magnets, collecting nets, notebooks, and safety goggles; timing devices, including clocks and timers; non-standard measuring items such as paper clips and clothespins; weather instruments such as classroom demonstration thermometers and wind socks; and materials to support observations of habitats of organisms such as aquariums and terrariums; and
  - (B) measure and compare organisms and objects using non-standard units.
- (5) Matter and energy. The student knows that objects have properties and patterns. The student is expected to:
  - (A) classify objects by observable properties of the materials from which they are made such as larger and smaller, heavier and lighter, shape, color, and texture; and
  - (B) predict and identify changes in materials caused by heating and cooling such as ice melting, water freezing, and water evaporating.
- (6) Force, motion, and energy. The student knows that force, motion, and energy are related and are a part of everyday life. The student is expected to:
  - (A) identify and discuss how different forms of energy such as light, heat, and sound are important to everyday life;
  - (B) predict and describe how a magnet can be used to push or pull an object;
  - (C) describe the change in the location of an object such as closer to, nearer to, and farther from; and
  - (D) demonstrate and record the ways that objects can move such as in a straight line, zig zag, up and down, back and forth, round and round, and fast and slow.
- (7) Earth and space. The student knows that the natural world includes rocks, soil, and water that can be observed in cycles, patterns, and systems. The student is expected to:
  - (A) observe, compare, describe, and sort components of soil by size, texture, and color;
  - (B) identify and describe a variety of natural sources of water, including streams, lakes, and oceans; and
  - (C) gather evidence of how rocks, soil, and water help to make useful products.
- (8) Earth and space. The student knows that the natural world includes the air around us and objects in the sky. The student is expected to:
  - (A) record weather information, including relative temperature, such as hot or cold, clear or cloudy, calm or windy, and rainy or icy;
  - (B) observe and record changes in the appearance of objects in the sky such as clouds, the Moon, and stars, including the Sun;
  - (C) identify characteristics of the seasons of the year and day and night; and

- (D) demonstrate that air is all around us and observe that wind is moving air.
- (9) Organisms and environments. The student knows that the living environment is composed of relationships between organisms and the life cycles that occur. The student is expected to:
  - (A) sort and classify living and nonliving things based upon whether or not they have basic needs and produce offspring;
  - (B) analyze and record examples of interdependence found in various situations such as terrariums and aquariums or pet and caregiver; and
  - (C) gather evidence of interdependence among living organisms such as energy transfer through food chains and animals using plants for shelter.
- (10) Organisms and environments. The student knows that organisms resemble their parents and have structures and processes that help them survive within their environments. The student is expected to:
  - (A) investigate how the external characteristics of an animal are related to where it lives, how it moves, and what it eats;
  - (B) identify and compare the parts of plants;
  - (C) compare ways that young animals resemble their parents; and
  - (D) observe and record life cycles of animals such as a chicken, frog, or fish.

*Source: The provisions of this §112.12 adopted to be effective August 4, 2009, 34 TexReg 5063.*

### **§112.13. Science, Grade 2, Beginning with School Year 2010-2011.**

- (a) Introduction.
  - (1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."
  - (2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.
  - (3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 60% of instructional time.
  - (4) In Grade 2, careful observation and investigation are used to learn about the natural world and reveal patterns, changes, and cycles. Students should understand that certain types of questions can be answered by using observation and investigations and that the information gathered in these may change as new observations are made. As students participate in investigation, they develop the skills necessary to do science as well as develop new science concepts.
    - (A) Within the physical environment, students expand their understanding of the properties of objects such as shape, mass, temperature, and flexibility then use those properties to compare, classify, and then combine the objects to do something that they could not do before. Students manipulate objects to demonstrate a change in motion and position.
    - (B) Within the natural environment, students will observe the properties of earth materials as well as predictable patterns that occur on Earth and in the sky. The students understand that those patterns are used to make choices in clothing, activities, and transportation.
    - (C) Within the living environment, students explore patterns, systems, and cycles by investigating characteristics of organisms, life cycles, and interactions among all the

components within their habitat. Students examine how living organisms depend on each other and on their environment.

(b) Knowledge and skills.

- (1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures. The student is expected to:
  - (A) identify and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately;
  - (B) describe the importance of safe practices; and
  - (C) identify and demonstrate how to use, conserve, and dispose of natural resources and materials such as conserving water and reuse or recycling of paper, plastic, and metal.
- (2) Scientific investigation and reasoning. The student develops abilities necessary to do scientific inquiry in classroom and outdoor investigations. The student is expected to:
  - (A) ask questions about organisms, objects, and events during observations and investigations;
  - (B) plan and conduct descriptive investigations such as how organisms grow;
  - (C) collect data from observations using simple equipment such as hand lenses, primary balances, thermometers, and non-standard measurement tools;
  - (D) record and organize data using pictures, numbers, and words;
  - (E) communicate observations and justify explanations using student-generated data from simple descriptive investigations; and
  - (F) compare results of investigations with what students and scientists know about the world.
- (3) Scientific investigation and reasoning. The student knows that information and critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. The student is expected to:
  - (A) identify and explain a problem in his/her own words and propose a task and solution for the problem such as lack of water in a habitat;
  - (B) make predictions based on observable patterns; and
  - (C) identify what a scientist is and explore what different scientists do.
- (4) Scientific investigation and reasoning. The student uses age-appropriate tools and models to investigate the natural world. The student is expected to:
  - (A) collect, record, and compare information using tools, including computers, hand lenses, rulers, primary balances, plastic beakers, magnets, collecting nets, notebooks, and safety goggles; timing devices, including clocks and stopwatches; weather instruments such as thermometers, wind vanes, and rain gauges; and materials to support observations of habitats of organisms such as terrariums and aquariums; and
  - (B) measure and compare organisms and objects using non-standard units that approximate metric units.
- (5) Matter and energy. The student knows that matter has physical properties and those properties determine how it is described, classified, changed, and used. The student is expected to:
  - (A) classify matter by physical properties, including shape, relative mass, relative temperature, texture, flexibility, and whether material is a solid or liquid;
  - (B) compare changes in materials caused by heating and cooling;

- (C) demonstrate that things can be done to materials to change their physical properties such as cutting, folding, sanding, and melting; and
  - (D) combine materials that when put together can do things that they cannot do by themselves such as building a tower or a bridge and justify the selection of those materials based on their physical properties.
- (6) Force, motion, and energy. The student knows that forces cause change and energy exists in many forms. The student is expected to:
- (A) investigate the effects on an object by increasing or decreasing amounts of light, heat, and sound energy such as how the color of an object appears different in dimmer light or how heat melts butter;
  - (B) observe and identify how magnets are used in everyday life;
  - (C) trace the changes in the position of an object over time such as a cup rolling on the floor and a car rolling down a ramp; and
  - (D) compare patterns of movement of objects such as sliding, rolling, and spinning.
- (7) Earth and space. The student knows that the natural world includes earth materials. The student is expected to:
- (A) observe and describe rocks by size, texture, and color;
  - (B) identify and compare the properties of natural sources of freshwater and saltwater; and
  - (C) distinguish between natural and manmade resources.
- (8) Earth and space. The student knows that there are recognizable patterns in the natural world and among objects in the sky. The student is expected to:
- (A) measure, record, and graph weather information, including temperature, wind conditions, precipitation, and cloud coverage, in order to identify patterns in the data;
  - (B) identify the importance of weather and seasonal information to make choices in clothing, activities, and transportation;
  - (C) explore the processes in the water cycle, including evaporation, condensation, and precipitation, as connected to weather conditions; and
  - (D) observe, describe, and record patterns of objects in the sky, including the appearance of the Moon.
- (9) Organisms and environments. The student knows that living organisms have basic needs that must be met for them to survive within their environment. The student is expected to:
- (A) identify the basic needs of plants and animals;
  - (B) identify factors in the environment, including temperature and precipitation, that affect growth and behavior such as migration, hibernation, and dormancy of living things; and
  - (C) compare and give examples of the ways living organisms depend on each other and on their environments such as food chains within a garden, park, beach, lake, and wooded area.
- (10) Organisms and environments. The student knows that organisms resemble their parents and have structures and processes that help them survive within their environments. The student is expected to:
- (A) observe, record, and compare how the physical characteristics and behaviors of animals help them meet their basic needs such as fins help fish move and balance in the water;



- (B) observe, record, and compare how the physical characteristics of plants help them meet their basic needs such as stems carry water throughout the plant; and
- (C) investigate and record some of the unique stages that insects undergo during their life cycle.

*Source: The provisions of this §112.13 adopted to be effective August 4, 2009, 34 TexReg 5063.*

**§112.14. Science, Grade 3, Beginning with School Year 2010-2011.**

(a) Introduction.

- (1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."
- (2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.
- (3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific methods, analyzing information, making informed decisions, and using tools to collect and record information while addressing the content and vocabulary in physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 60% of instructional time.
- (4) In Grade 3, students learn that the study of science uses appropriate tools and safe practices in planning and implementing investigations, asking and answering questions, collecting data by observing and measuring, and by using models to support scientific inquiry about the natural world.
  - (A) Students recognize that patterns, relationships, and cycles exist in matter. Students will investigate the physical properties of matter and will learn that changes occur. They explore mixtures and investigate light, sound, and heat/thermal energy in everyday life. Students manipulate objects by pushing and pulling to demonstrate changes in motion and position.
  - (B) Students investigate how the surface of Earth changes and provides resources that humans use. As students explore objects in the sky, they describe how relationships affect patterns and cycles on Earth. Students will construct models to demonstrate Sun, Earth, and Moon system relationships and will describe the Sun's role in the water cycle.
  - (C) Students explore patterns, systems, and cycles within environments by investigating characteristics of organisms, life cycles, and interactions among all components of the natural environment. Students examine how the environment plays a key role in survival. Students know that when changes in the environment occur organisms may thrive, become ill, or perish.

(b) Knowledge and skills.

- (1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following school and home safety procedures and environmentally appropriate practices. The student is expected to:
  - (A) demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including observing a schoolyard habitat; and
  - (B) make informed choices in the use and conservation of natural resources by recycling or reusing materials such as paper, aluminum cans, and plastics.
- (2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations. The student is expected to:

- (A) plan and implement descriptive investigations, including asking and answering questions, making inferences, and selecting and using equipment or technology needed, to solve a specific problem in the natural world;
  - (B) collect data by observing and measuring using the metric system and recognize differences between observed and measured data;
  - (C) construct maps, graphic organizers, simple tables, charts, and bar graphs using tools and current technology to organize, examine, and evaluate measured data;
  - (D) analyze and interpret patterns in data to construct reasonable explanations based on evidence from investigations;
  - (E) demonstrate that repeated investigations may increase the reliability of results; and
  - (F) communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.
- (3) Scientific investigation and reasoning. The student knows that information, critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. The student is expected to:
- (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
  - (B) draw inferences and evaluate accuracy of product claims found in advertisements and labels such as for toys and food;
  - (C) represent the natural world using models such as volcanoes or Sun, Earth, and Moon system and identify their limitations, including size, properties, and materials; and
  - (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
- (4) Scientific investigation and reasoning. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:
- (A) collect, record, and analyze information using tools, including microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, wind vanes, rain gauges, pan balances, graduated cylinders, beakers, spring scales, hot plates, meter sticks, compasses, magnets, collecting nets, notebooks, sound recorders, and Sun, Earth, and Moon system models; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums; and
  - (B) use safety equipment as appropriate, including safety goggles and gloves.
- (5) Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to:
- (A) measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float;
  - (B) describe and classify samples of matter as solids, liquids, and gases and demonstrate that solids have a definite shape and that liquids and gases take the shape of their container;
  - (C) predict, observe, and record changes in the state of matter caused by heating or cooling; and
  - (D) explore and recognize that a mixture is created when two materials are combined such as gravel and sand and metal and plastic paper clips.

- (6) Force, motion, and energy. The student knows that forces cause change and that energy exists in many forms. The student is expected to:
  - (A) explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life;
  - (B) demonstrate and observe how position and motion can be changed by pushing and pulling objects to show work being done such as swings, balls, pulleys, and wagons; and
  - (C) observe forces such as magnetism and gravity acting on objects.
- (7) Earth and space. The student knows that Earth consists of natural resources and its surface is constantly changing. The student is expected to:
  - (A) explore and record how soils are formed by weathering of rock and the decomposition of plant and animal remains;
  - (B) investigate rapid changes in Earth's surface such as volcanic eruptions, earthquakes, and landslides;
  - (C) identify and compare different landforms, including mountains, hills, valleys, and plains; and
  - (D) explore the characteristics of natural resources that make them useful in products and materials such as clothing and furniture and how resources may be conserved.
- (8) Earth and space. The student knows there are recognizable patterns in the natural world and among objects in the sky. The student is expected to:
  - (A) observe, measure, record, and compare day-to-day weather changes in different locations at the same time that include air temperature, wind direction, and precipitation;
  - (B) describe and illustrate the Sun as a star composed of gases that provides light and heat energy for the water cycle;
  - (C) construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions; and
  - (D) identify the planets in Earth's solar system and their position in relation to the Sun.
- (9) Organisms and environments. The student knows that organisms have characteristics that help them survive and can describe patterns, cycles, systems, and relationships within the environments. The student is expected to:
  - (A) observe and describe the physical characteristics of environments and how they support populations and communities within an ecosystem;
  - (B) identify and describe the flow of energy in a food chain and predict how changes in a food chain affect the ecosystem such as removal of frogs from a pond or bees from a field; and
  - (C) describe environmental changes such as floods and droughts where some organisms thrive and others perish or move to new locations.
- (10) Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environments. The student is expected to:
  - (A) explore how structures and functions of plants and animals allow them to survive in a particular environment;
  - (B) explore that some characteristics of organisms are inherited such as the number of limbs on an animal or flower color and recognize that some behaviors are learned in response to living in a certain environment such as animals using tools to get food; and

- (C) investigate and compare how animals and plants undergo a series of orderly changes in their diverse life cycles such as tomato plants, frogs, and lady bugs.

*Source: The provisions of this §112.14 adopted to be effective August 4, 2009, 34 TexReg 5063.*

**§112.15. Science, Grade 4, Beginning with School Year 2010-2011.**

(a) Introduction.

- (1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."
- (2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.
- (3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 50% of instructional time.
- (4) In Grade 4, investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations and that methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. They have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.
  - (A) Within the natural environment, students know that earth materials have properties that are constantly changing due to Earth's forces. The students learn that the natural world consists of resources, including renewable and nonrenewable, and their responsibility to conserve our natural resources for future generations. They will also explore Sun, Earth, and Moon relationships. The students will recognize that our major source of energy is the Sun.
  - (B) Within the living environment, students know and understand that living organisms within an ecosystem interact with one another and with their environment. The students will recognize that plants and animals have basic needs, and they are met through a flow of energy known as food webs. Students will explore how all living organisms go through a life cycle and that adaptations enable organisms to survive in their ecosystem.

(b) Knowledge and skills.

- (1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations, following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:
  - (A) demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations; and
  - (B) make informed choices in the use and conservation of natural resources and reusing and recycling of materials such as paper, aluminum, glass, cans, and plastic.
- (2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations. The student is expected to:
  - (A) plan and implement descriptive investigations, including asking well-defined questions, making inferences, and selecting and using appropriate equipment or technology to answer his/her questions;

- (B) collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps;
  - (C) construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data;
  - (D) analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured;
  - (E) perform repeated investigations to increase the reliability of results; and
  - (F) communicate valid, oral, and written results supported by data.
- (3) Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
- (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
  - (B) draw inferences and evaluate accuracy of services and product claims found in advertisements and labels such as for toys, food, and sunscreen;
  - (C) represent the natural world using models such as rivers, stream tables, or fossils and identify their limitations, including accuracy and size; and
  - (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
- (4) Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry. The student is expected to:
- (A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, pan balances, triple beam balances, graduated cylinders, beakers, hot plates, meter sticks, compasses, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums; and
  - (B) use safety equipment as appropriate, including safety goggles and gloves.
- (5) Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to:
- (A) measure, compare, and contrast physical properties of matter, including size, mass, volume, states (solid, liquid, gas), temperature, magnetism, and the ability to sink or float;
  - (B) predict the changes caused by heating and cooling such as ice becoming liquid water and condensation forming on the outside of a glass of ice water; and
  - (C) compare and contrast a variety of mixtures and solutions such as rocks in sand, sand in water, or sugar in water.
- (6) Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems. The student is expected to:
- (A) differentiate among forms of energy, including mechanical, sound, electrical, light, and heat/thermal;
  - (B) differentiate between conductors and insulators;
  - (C) demonstrate that electricity travels in a closed path, creating an electrical circuit, and explore an electromagnetic field; and

- (D) design an experiment to test the effect of force on an object such as a push or a pull, gravity, friction, or magnetism.
- (7) Earth and space. The students know that Earth consists of useful resources and its surface is constantly changing. The student is expected to:
  - (A) examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants;
  - (B) observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice; and
  - (C) identify and classify Earth's renewable resources, including air, plants, water, and animals; and nonrenewable resources, including coal, oil, and natural gas; and the importance of conservation.
- (8) Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to:
  - (A) measure and record changes in weather and make predictions using weather maps, weather symbols, and a map key;
  - (B) describe and illustrate the continuous movement of water above and on the surface of Earth through the water cycle and explain the role of the Sun as a major source of energy in this process; and
  - (C) collect and analyze data to identify sequences and predict patterns of change in shadows, tides, seasons, and the observable appearance of the Moon over time.
- (9) Organisms and environments. The student knows and understands that living organisms within an ecosystem interact with one another and with their environment. The student is expected to:
  - (A) investigate that most producers need sunlight, water, and carbon dioxide to make their own food, while consumers are dependent on other organisms for food; and
  - (B) describe the flow of energy through food webs, beginning with the Sun, and predict how changes in the ecosystem affect the food web such as a fire in a forest.
- (10) Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environment. The student is expected to:
  - (A) explore how adaptations enable organisms to survive in their environment such as comparing birds' beaks and leaves on plants;
  - (B) demonstrate that some likenesses between parents and offspring are inherited, passed from generation to generation such as eye color in humans or shapes of leaves in plants. Other likenesses are learned such as table manners or reading a book and seals balancing balls on their noses; and
  - (C) explore, illustrate, and compare life cycles in living organisms such as butterflies, beetles, radishes, or lima beans.

*Source: The provisions of this §112.15 adopted to be effective August 4, 2009, 34 TexReg 5063.*

#### **§112.16. Science, Grade 5, Beginning with School Year 2010-2011.**

- (a) Introduction.
  - (1) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process."
  - (2) Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include patterns, cycles, systems, models, and change and constancy.

- (3) The study of elementary science includes planning and safely implementing classroom and outdoor investigations using scientific processes, including inquiry methods, analyzing information, making informed decisions, and using tools to collect and record information, while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. Districts are encouraged to facilitate classroom and outdoor investigations for at least 50% of instructional time.
- (4) In Grade 5, investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations and that methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. They have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.
  - (A) Within the physical environment, students learn about the physical properties of matter, including magnetism, physical states of matter, relative density, solubility in water, and the ability to conduct or insulate electrical and heat energy. Students explore the uses of light, thermal, electrical, and sound energies.
  - (B) Within the natural environment, students learn how changes occur on Earth's surface and that predictable patterns occur in the sky. Students learn that the natural world consists of resources, including nonrenewable, renewable, and alternative energy sources.
  - (C) Within the living environment, students learn that structure and function of organisms can improve the survival of members of a species. Students learn to differentiate between inherited traits and learned behaviors. Students learn that life cycles occur in animals and plants and that the carbon dioxide-oxygen cycle occurs naturally to support the living environment.
- (b) Knowledge and skills.
  - (1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:
    - (A) demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations; and
    - (B) make informed choices in the conservation, disposal, and recycling of materials.
  - (2) Scientific investigation and reasoning. The student uses scientific methods during laboratory and outdoor investigations. The student is expected to:
    - (A) describe, plan, and implement simple experimental investigations testing one variable;
    - (B) ask well-defined questions, formulate testable hypotheses, and select and use appropriate equipment and technology;
    - (C) collect information by detailed observations and accurate measuring;
    - (D) analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence;
    - (E) demonstrate that repeated investigations may increase the reliability of results;
    - (F) communicate valid conclusions in both written and verbal forms; and
    - (G) construct appropriate simple graphs, tables, maps, and charts using technology, including computers, to organize, examine, and evaluate information.
  - (3) Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

- (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
  - (B) evaluate the accuracy of the information related to promotional materials for products and services such as nutritional labels;
  - (C) draw or develop a model that represents how something works or looks that cannot be seen such as how a soda dispensing machine works; and
  - (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
- (4) Scientific investigation and reasoning. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:
- (A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, prisms, mirrors, pan balances, triple beam balances, spring scales, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observations of habitats or organisms such as terrariums and aquariums; and
  - (B) use safety equipment, including safety goggles and gloves.
- (5) Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to:
- (A) classify matter based on physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating), solubility in water, and the ability to conduct or insulate thermal energy or electric energy;
  - (B) identify the boiling and freezing/melting points of water on the Celsius scale;
  - (C) demonstrate that some mixtures maintain physical properties of their ingredients such as iron filings and sand; and
  - (D) identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving salt in water or adding lemon juice to water.
- (6) Force, motion, and energy. The student knows that energy occurs in many forms and can be observed in cycles, patterns, and systems. The student is expected to:
- (A) explore the uses of energy, including mechanical, light, thermal, electrical, and sound energy;
  - (B) demonstrate that the flow of electricity in circuits requires a complete path through which an electric current can pass and can produce light, heat, and sound;
  - (C) demonstrate that light travels in a straight line until it strikes an object or travels through one medium to another and demonstrate that light can be reflected such as the use of mirrors or other shiny surfaces and refracted such as the appearance of an object when observed through water; and
  - (D) design an experiment that tests the effect of force on an object.
- (7) Earth and space. The student knows Earth's surface is constantly changing and consists of useful resources. The student is expected to:
- (A) explore the processes that led to the formation of sedimentary rocks and fossil fuels;
  - (B) recognize how landforms such as deltas, canyons, and sand dunes are the result of changes to Earth's surface by wind, water, and ice;



- (C) identify alternative energy resources such as wind, solar, hydroelectric, geothermal, and biofuels; and
  - (D) identify fossils as evidence of past living organisms and the nature of the environments at the time using models.
- (8) Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to:
- (A) differentiate between weather and climate;
  - (B) explain how the Sun and the ocean interact in the water cycle;
  - (C) demonstrate that Earth rotates on its axis once approximately every 24 hours causing the day/night cycle and the apparent movement of the Sun across the sky; and
  - (D) identify and compare the physical characteristics of the Sun, Earth, and Moon.
- (9) Organisms and environments. The student knows that there are relationships, systems, and cycles within environments. The student is expected to:
- (A) observe the way organisms live and survive in their ecosystem by interacting with the living and non-living elements;
  - (B) describe how the flow of energy derived from the Sun, used by producers to create their own food, is transferred through a food chain and food web to consumers and decomposers;
  - (C) predict the effects of changes in ecosystems caused by living organisms, including humans, such as the overpopulation of grazers or the building of highways; and
  - (D) identify the significance of the carbon dioxide-oxygen cycle to the survival of plants and animals.
- (10) Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environments. The student is expected to:
- (A) compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals;
  - (B) differentiate between inherited traits of plants and animals such as spines on a cactus or shape of a beak and learned behaviors such as an animal learning tricks or a child riding a bicycle; and
  - (C) describe the differences between complete and incomplete metamorphosis of insects.

*Source: The provisions of this §112.16 adopted to be effective August 4, 2009, 34 TexReg 5063.*